HIGH VOLT

Cable End Termination Systems

Type CETS, 100 kV up to 800 kV

7.90/3

Situation & Application

Cable Terminations

HV tests of extruded cables require special measures for the connection of the HV source to the cable under test. Water-controlled cable end termination systems allow a reliable and easy handle of this connection. The required international standards and requirements for testing cables are all fulfilled by using our cable end termination systems (IEC 60840 / 30-150kV, IEC 62067 / 150-550kV, IEC 60060-1, IEC 60060-2, IEC 60270).

Cable End Termination Systems (CETS) are designed and manufactured for **routine and type testing of medium, high and extra high voltage plastic-insulated cables**. Additionally, the system can also be operated in the framework of development tests and other applications as:

- HV AC withstand tests
- PD measurement tests (the terminations are PD free up to the rated voltage of the system)
- HV impulse (LI and SI) tests
- Step-up tests
- HV AC long term tests (the system is designed for continuous duty cycle)
- C/tan δ measurement on request (special preparation of the cable ends without changing of water end terminations)

Notice, CETS are not intended for cable operation or service after installation. In addition, if high current tests above 100 A are needed, this has to be considered from case to case.

The CETS series includes terminations from 100 kV up to 800 kV for a maximum cable diameter of 160 mm over the outer semi-conducting layer. Cable end terminations are based on the field control within the end termination and in the ambient air by using water with a specific and adjustable conductivity. Due to the concept of the fully automatic control of the conductivity, the temperature as well as the filling and emptying process, the cable end termination systems are perfectly suited to perform all above mentioned tests. They were developed in such a way that they can be delivered as fully automatic stand-alone systems. The great advantage for the user is a comfortable and easy integration into the existing control and measuring system of the HV test equipment via a fibre optic link.

Fig. 1: View of a cable end termination for 300 kV, CET 300/120

The general principle is based on the field-control by using deionised water with a specific, controllable conductivity together with its high dielectric constant. As cable diameters can vary the electric field distribution can change significantly within the same cable end termination. Thus a suitable field-control is needed, that means the correct conductivity within the cable termination is crucial and thus an important design factor of the cable end terminations. Furthermore, one negative consequence of using water with limited conductivity as a medium for the correct field-control, electric energy is dissipated within the water. This may lead to a significant and unwanted temperature rise. This effect is avoided by the application of an effective cooling system for the water and by choosing the correct conductivity.

The main components of the cable end termination system consist of two cable end terminations CET for each end of the cable to be tested and the water conditioning unit, CEU, see title figure. Additionally, accessories like silicone sealing compound, deionisation resin, water tubes and spare parts complete this testing system. The cable is inserted from below into the end termination for voltages up to 800 kV, Fig. 1.

The termination CET is designed as a 2-tube system in which the deionised water circulates. Together with the water conditioning unit a closed water system is formed. Each cable termination is connected by two hoses to the water conditioning unit, see title figure.

Fig. 2: CET 300/120 with manual jacking system

Fig. 3: CET 300/120 with motorized jacking system

To lift the CET a standard version with manual jacking system, Fig. 2, is available. The motorized version, Fig. 3, is offered as an option.

Water Processing Unit

Two water processing units, type CEU are available to cover all needs for the voltage levels from 100 kV up to 800 kV. Design and geometry of the cables to be tested change the field distribution and energy losses within the cable end termination. The water conditioning unit is the key component which controls both conductivity and temperature of the water circulating through the cable end terminations.

The water conditioning unit (Fig. 4) is equipped with a sufficient water reservoir which holds the deionised water. Together with the two cable terminations, which are connected by four hoses with the water conditioning unit, a closed water system is formed, see title figure. By an effective pump, the water is circulated with a flow rate of 30 l/min. or 60 l/min. through the cable end terminations. With the help of a heat exchanger the excess heat is taken away by external cooling water. The conductivity is controlled by a deionisation resin contained in a bottle. The arrangement of this bottle within the water circulating system in conjunction with the conductivity control allows a very long life time of about one year, even if the system is used intensively.

Control of water condition:
The four different operation states
- Deionisation / Internal circulation
- Charging / External Circulation
- Testing / External Circulation
- Discharging

can easily be selected by buttons on the touch panel (Fig. 5).

All operation states, critical values like conductivity, temperature, and water flow rate can be preset and are automatically processed and controlled. No manual operations are necessary like opening and closing valves or a manual correction of the conductivity during a HV test. If critical conditions occur, as water leaks or overheating, a signal is produced and the high-voltage will be automatically switched off. Fig. 6 shows as an example the visualization of the key parameters during cable testing on the CEU touch screen.

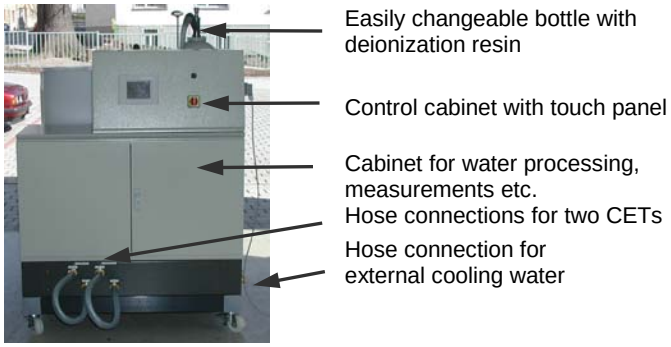

Fig. 4: Front view of CEU 120

Via a fibre optic link and by the PROFIBUS system, the water conditioning unit can be incorporated in the HIGHVOLT control and measurement system of high voltage AC and LI sources.

This allows visualization on a central display, the remote control of all parameters and the starting of all processes of the CEU. Furthermore, for very high voltage applications and power, two CEUs can be controlled by only one touch panel, as the two water conditioning units can be connected by one optical fibre link.

As heat losses rise strongly with the increase of the applied voltage level and by decrease of the cable diameter (volume of water is increased), cooling capacities for the CEUs cover two ranges. The smallest CEU has a maximum cooling capacity of 60 kW and the larger version is equipped with a cooling capacity of 120 kW.

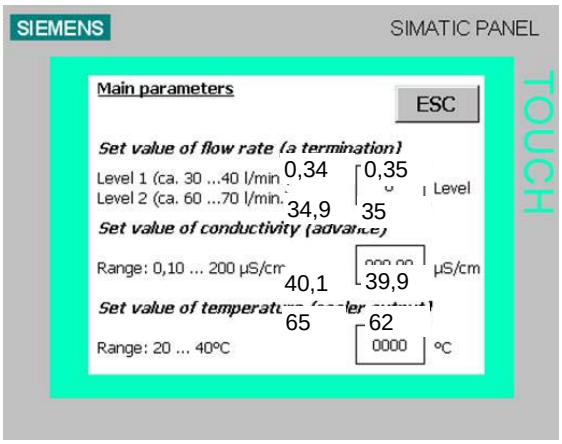

Fig. 5: Visualization of key parameters on the CEU touch screen during testing

Available Systems

Type designation for the cable end termination systems and their components is as follows:

The system (consisting of two cable end terminations together with the water conditioning unit):

CETS a/b-c

- a rated voltage in kV
- b maximum cable diameter in mm across semi-conducting layer
- c maximum cooling capacity in kW

Example: CETS 350/120-60 is a system for 350 kV, 120 mm across semi-conducting layer, 60 kW cooling capacity

Further technical information about the components can be found in the HIGHVOLT Data Sheets No. 7.93 and 7.95

The cable terminations alone:

CET a/b G

- a rated voltage
- b maximum cable diameter in mm across semi-conducting layer
- G guard electrode for tan δ measurement (as option)

Example: CET 350/120 is a pair of cable end termination for 350 kV, 120 mm across semi-conducting layer

The water conditioning unit:

CEU c R

- c maximum cooling capacity
- R remote control (as option)

Example: CEU 120 means a water conditioning unit with 120 kW cooling capacity

Type	Pair of cable terminations	Water Conditioning Unit	Accessories [2)]
CETS 100/120-60	CET 100/120	CEU 60	CEA 100/120
CETS 150/120-60	CET 150/120	CEU 60	CEA 150/120
CETS 200/120-60	CET 200/120	CEU 60	CEA 200/120
CETS 250/120-60	CET 250/120	CEU 60	CEA 250/120
CETS 300/120-60	CET 300/120	CEU 60	CEA 300/120
CETS 350/120-60	CET 350/120	CEU 60	CEA 350/120
CETS 350/160-60	CET 350/160	CEU 60	CEA 350/160
CETS 400/120-60	CET 400/120	CEU 60	CEA 400/120
CETS 400/160-120	CET 400/160	CEU 120	CEA 400/160
CETS 500/120-120	CET 500/120	CEU 120	CEA 500/120
CETS 500/160-120	CET 500/160	CEU 120	CEA 500/160
CETS 600/120-120	CET 600/120	CEU 120 [1)]	CEA 600/120
CETS 600/160-120	CET 600/160	CEU 120 [1)]	CEA 600/160
CETS 700/120-240	CET 700/120	2 x CEU 120	CEA 700/120
CETS 700/160-240	CET 700/160	2 x CEU 120	CEA 700/160
CETS 800/160-240	CET 800/160	2 x CEU 120	CEA 800/160
Detailed technical data	see data sheet 7.93	see data sheet 7.95	

Table 1: Overview of cable end termination system CETS

[1)] optional are also two CEU 120, each for one cable end termination
[2)] includes spare parts, silicone sealing compound, deionization resin

For further information please contact:

HIGHVOLT Prüftechnik Dresden GmbH
Marie-Curie-Straße 10
D-01139 Dresden / Germany
Telephone: ++49 351 84 25-648
Fax: ++49 351 84 25-679
e-mail: dresden@highvolt.de
web site: www.highvolt.de

or our local representative: